



Interagency Depainting Study Status

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Regulatory Background



- The National Emission Standards for Hazardous Air Pollutants for Aerospace Manufacturing and Rework Facilities (**Aerospace NESHAP**) regulates Depainting Operations
 - limits methylene chloride usage for coating removal
 - commercial** : 26 gallons/craft/year
 - military**: 50 gallons/craft/year

Regulatory... (Continued)



- Initial Aerospace NESHAP promulgated in **September 1995** - subsequent versions exist.
- First substantive compliance date for existing sources is **September 1998**.
- The Occupational Safety & Health Administration (OSHA) established stringent Permissible Exposure Limits (PEL) effective April 1997.

Partners are:



- EPA
Emission Standards Division (ESD)
- NASA
Headquarters, Code JE
Marshall Space Flight Center (MSFC)
- USAF
Robins Air Force Base (RAFB)
Wright Patterson Air Force Base (WPAFB)



Committees are:

- Executive Steering Task Force (ESTF)
comprised of EPA/HQ, EPA/ESD, NASA/HQ, and NASA/MSFC
- Technical Implementation Committee (TIC)
comprised of NASA/MSFC
- Technical Advisory Committee (TAC)
comprised of EPA/ESD, NASA/HQ, NASA/MSFC, USAF/WPAFB, USAF/WRAFB, USCG, General Aviation and Airline Industry

Processes Being Evaluated



- Chemical Stripping
- COLDJET™ (CO₂ Blasting)
- TOMCO₂ (CO₂ Blasting)
- FLASHJET™ Coating Removal
- Laser Stripping
- Plastic Media Blasting
- Sodium Bicarbonate Wet Stripping
- Water Stripping
- Wheat Starch Blasting

* COLDJET™ and TOMCO₂ processes deleted from evaluation after 1st stripping.



Initial Parameters of the Study

- Substrates
 - 2024-T3 clad Al, in 64, 32, and 16 mil thicknesses
 - 2024-T3 non-clad Al, in 64, 51, and 16 mil thicknesses
- Paint System
 - primer: MIL-P-23377F, Type 1, Class 2
 - topcoat: MIL-C-83286B, urethane
- Five sequences of panel preparation and stripping.



Current Parameters of the Study

- Substrates - no change
- Paint System (implemented in 2nd sequence)
 - primer: no change
 - topcoat: MIL-C-85285B (high solids, low voc)
 - previous topcoat no longer available from vendor
- Three to five sequences of panel preparation and stripping.

Stages in Each Sequence



- Coating Application
- Measurements - coating thickness
- Aging
- Stripping
- Measurements - substrate thickness, surface roughness
- Specimen Cleaning - WBF surface
- Chromate Conversion
- Measurements - substrate thickness and weight, surface roughness
- Repeat for next sequence

Preparation of the Test Specimens



● Cleaning Steps:

MEK hand clean.

Vapor degrease with perchlorethylene, 10 min.

Immerse in Turco 4215, 25 min.

Hot DI water rinse, 5 min.

Immerse in Turco Smut-Go #1, 11 min.

Cold DI water rinse, 5 min.

WBF test, DI water.

Test Specimens (Continued)



- Aging Steps per ***ISO/SAE MA4872***:

Precondition : 12 hours @ 120F, 95%RH

Hold at -65 for 1 hour

Thermally cycle for -65F to 160F 400x.

Return to chamber to ambient temperature.

Repeat steps 1-3.

Material Evaluation Testing



- Fatigue and Tensile - *baseline & final stripping*
- Sandwich & Immersion Corrosion - *completed*
- Hydrogen Embrittlement - *completed except for Gage*
- Crack Detectability - *PMB, Wheatstarch, Sodablast, on-going*
- Clad Penetration-*baseline & final stripping*
- Surface Roughness - *on-going*
- Material Loss, Change in Thickness - *on-going*

Status to Date



● Current process status:

Chemical Stripping	completed 4 of 5 strippings
COLDJET™	dropped from study
TOMCO ₂	dropped from study
FLashjet™	completed 3 of 3 strippings
Laser Stripping	completed 2 of 3 strippings
Plastic Media Blasting	completed 3 of 4 strippings
Sodium Bicarb. Wet Stripping	completed 3 of 3 strippings
Water Stripping	completed 3 of 3 strippings
Wheat Starch Stripping	completed 3 of 3 strippings

Next Steps

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- Conclude stripping sequences.
- Initiate final material testing to compare to baselines.
- Evaluate process performance.
- Provide conclusions to EPA.
- Targeted conclusion of study is December 1998.



Process Comparisons

- Unable to recommend one process over another due to following:
 - manual vs. automatic
 - ease of use, operability
 - capital investment costs
 - no final fatigue data at present

Chemical Stripping



- Data taken from three sequences.
- Approximately 40 candidates - downselected to 10 chemical strippers (5 alkalines & 5 acids)

Chemical Type	Dwell Time
Baselines	12 minutes
Alkalines/Neutrals	5.3 hours
Acids	5 hours

CO₂ Blasting



- Two systems: COLDJET™ Model 65-250 and TOMCO₂ DI-250.
- COLDJET™ system caused significant deformation on 16 mil specimens and even 64 mil specimens showed surface damage.
- TOMCO₂ system was capable of some coating removal but allowable pressure was too low for efficient stripping.

Flashjet™ Coating Removal



- Generous time and effort donated by McDonnell Douglas in St. Louis, MO.
- Data taken from two sequences.

Substrate Thickness	Strip Rate
16 mils	109 in ² /min
51 mils	136 in ² /min
64 mils	128 in ² /min

Plastic Media Blasting



- Data taken from two sequences.
- Media: type V Plastic Media, 20/30 & 16/20 mesh
- Nozzle diameters: 0.25" @ throat ,0.50" @ exit

Substrate Thickness	Blast Pressure	Strip Rate
16 mils	30 psi	17 in ² /min
51 mils	35 psi	20 in ² /min
64 mils	40 psi	18 in ² /min

Sodium Bicarbonate Wet Stripping



- Data taken from two sequences.
- First sequence was manual with great variance in strip rate.

Substrate Thickness	Strip Rate
16 mils	-----
51 mils	145 in ² /min
64 mils	167 in ² /min

Water Stripping



- Data taken from two sequences.
- Stripped using a customized system of robotics and spray equipment.

Substrate Thickness	Strip Rate
16 mils	139 in ² /min
51 mils	408 in ² /min
64 mils	390 in ² /min

Chemical Stripping



- Maintain environment at an rH of 34% and a temperature between 80 & 86 F.
- Apply fine mist of stripper over panel.
- Apply heavier mist 30 minutes later.
- Check at 2 hour intervals.
if any paint is released, brush panel and reapply stripper as before.



Wheat Starch Stripping

- Generous time and effort donated by CAE Electronics, Montreal Canada.
- Data taken from two sequences.

Process	Substrate Thickness	Strip Rate
semi-automated	16 mils	249 in ² /min
semi-automated	51 mils	459 in ² /min
semi-automated	64 mils	459 in ² /min
manual	16 mils	76 in ² /min
manual	51 mils	96 in ² /min
manual	64 mils	76 in ² /min